

**Before the  
Federal Communications Commission  
Washington, D.C. 20554**

In the Matter of	)	
	)	
Unlicensed Use of the 6 GHz Band	)	ET Docket No. 18-295
	)	
Expanding Flexible Use in Mid-Band	)	GN Docket No. 17-183
Spectrum Between 3.7 and 24 GHz	)	

**COMMENTS OF QUANTENNA COMMUNICATIONS, INC.**

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Quantenna Communications appreciates the FCC's efforts towards opening the 6GHz band for unlicensed usage. The timing of these efforts and proposal of the subject mentioned NPRM could not have been better to support the ever-growing demand of data for unlicensed Wi-Fi devices. This new band in unlicensed Wi-Fi domain will serve as a great medium for improving and providing free connectivity to masses for a very long time in the future.

Quantenna Communications is the global leader and innovator of high-performance Wi-Fi solutions. Founded in 2006, Quantenna has demonstrated its leadership in Wi-Fi technologies with many industry firsts. Quantenna continues to innovate with the mission to perfect Wi-Fi by establishing benchmarks for speed, range, efficiency and reliability. Quantenna takes a multi-dimensional approach, from silicon to communication system to software to hardware, all in a concerted effort to provide a complete Wi-Fi solution.

Based on the NPRM for unlicensed use of the 6 GHz band, we would like to provide a few comments and concerns on some of the questions raised by the FCC.

The FCC has proposed to open a total of 1200 MHz of band for unlicensed use, starting from 5.925 GHz to 7.125 GHz. Taking into account the density and nature of the current incumbents and services in this band, the FCC has divided this 6GHz band into four sub-bands which are:

1. U-NII-5 (5.925 – 6.425 GHz)
2. U-NII-6 (6.425 – 6.525 GHz)
3. U-NII-7 (6.525 – 6.875 GHz)
4. U-NII-8 (6.875 – 7.125 GHz)

We agree with the current proposed channelization. We would like to stress that these bands are critical for providing innovation and accessibility in unlicensed technologies, like Wi-Fi, and therefore these bands should not be made available for licensed use. The ever-growing need for high data rates in Wi-Fi demands the expansion of bandwidth and with this effort of FCC, we foresee that it will be possible to meet the requirement of extremely high throughput for end-users. However, if this band as a whole or in part is not available for unlicensed use then it shall definitely not only limit the potential innovation but also make it hard to meet the extremely high throughput requirement for unlicensed systems.

FCC's NPRM proposed two major rules for two types of unlicensed devices. The rationale was to protect incumbent services that operate in distinct parts of the 6 GHz band. Those two rules are:

- i. In the U-NII-5 and U-NII-7 sub-bands, unlicensed devices are only allowed to transmit under the control of an automated frequency control (AFC) system, details of which remain to be finalized.
- ii. In the U-NII-6 and U-NII-8 sub-bands, unlicensed devices are restricted only for an indoor usage and would operate at lower transmit power without the need of an AFC system.

## Summary Points:

The key summary points of this response are presented here as,

- In general, Quantenna Communications welcomes the efforts of FCC towards opening the 6 GHz band for unlicensed use and it strongly believes that this band as a whole or in part should not be considered for any commercial licensed operations.
- Quantenna Communications agrees with division of the 6 GHz band into 4 sub-bands as U-NII-5, U-NII-6, U-NII-7 and U-NII-8.
- Quantenna Communications does not support the idea of limiting the use of U-NII-5 and U-NII-7 bands only to standard power unlicensed devices.

- Quantenna Communications proposes opening the U-NII-5 and U-NII-7 bands to low power unlicensed devices under no AFC control.
- Quantenna Communications supports the idea of opening the U-NII-6 and U-NII-8 bands to low-power unlicensed devices under no AFC control.
- Quantenna Communications does not support the idea of limiting the U-NII-6 and U-NII-8 to only low-power unlicensed devices.
- Quantenna Communications proposes opening the U-NII-6 and U-NII-8 bands to standard power unlicensed devices under no AFC control as well.
- Quantenna Communications proposes to keep AFC as simple as possible and recommends that there should be no need of any professional installation required for devices operating at standard-power.
- Quantenna Communications does not support the OOB limits for U-NII-5.
- Quantenna Communications proposes to harmonize U-NII-5 OOB limits similar to the current U-NII-3 limits towards U-NII-4.
- Quantenna Communications does not support the idea of limiting the transmit power of unlicensed client devices to 63 mW.
- Quantenna Communications proposes to increase the transmit power limit of unlicensed client devices from 63 mW to 250 mW to increase the range on uplink across all 6 GHz bands.
- Quantenna Communications proposes that FCC regulates the access mechanism in 6 GHz band to make it fair for all devices which access the unlicensed band.

Details of the summary points is given in the following.

## U-NII-5 and U-NII-7

It is important to note that U-NII-5 band has 500 MHz bandwidth and U-NII-7 has 350 MHz of bandwidth. These are the two most significant bands in 6 GHz band. The rationale for rule (i) in these bands is to protect the point-to-point microwave links and fixed satellite communications.

### Limitations of rule (i)

Limiting the usage of U-NII-5 and U-NII-7 bands to only standard power devices (outdoor) with the need of an AFC like system is a huge limitation that shall result only in under-utilization of these bands. This rule seems to be stemming from the thinking that outdoor use of Wi-Fi is a significant part of Wi-Fi communication, which is a false assumption. This rule actually blocks indoor usage on these bands for Wi-Fi communication which results in reduced usage of these bands. Therefore, we do not support the idea of limiting the use of U-NII-5 and U-NII-7 bands only to standard power devices with an AFC like system. Please note that AFC is a great idea, but it can be a limiting factor due to its unclear nature and rules. Thus, we would support the idea of allowing the low-power unlicensed devices in U-NII-5 and U-NII-7 without any AFC like system.

### Support of Low-Power unlicensed devices in U-NII-5 and U-NII-7 without AFC

At this point limiting the usage of the U-NII-5 and U-NII-7 sub-band to only standard power (outdoor) devices is not justified as most of the Wi-Fi devices operate in indoor environments. We suggest that indoor unlicensed devices which transmit at lower power should be allowed to operate in U-NII-5 and U-NII-7 bands without the need of an AFC system. This shall not only increase the utilization of these bands for unlicensed devices but, at the same time due to lower power, shall not interfere with the current incumbents and services.

Currently, low power devices are only allowed in U-NII-6 and U-NII-8 bands, which is very welcoming but if we compare the joint bandwidth of U-NII-5 and U-NII-7 (850 MHz) as compared to the joint bandwidth of U-NII-6 and U-NII-8 (350 MHz), it is clear that U-NII-5 and U-NII-7 bands are far more preferable for having higher bandwidth channels (for example 160 MHz) as compared to U-NII-6 and U-NII-8. In the current proposed IEEE channelization, U-NII-5 and U-NII-7 can have up to four 160 MHz

channels, whereas U-NII-6 and U-NII-8 do not have a single 160 MHz channel. This is a huge limitation for achieving higher throughputs if U-NII-5 and U-NII-7 bands are restricted only for the outdoor environment under AFC control.

We cannot over-stress the need for more bandwidth in Wi-Fi since Wi-Fi is the most effective source of connecting all the devices in indoor environments. Therefore, restricting the U-NII-5 and U-NII-7 band to only outdoor with AFC shall make it impossible for the Wi-Fi to be able to provide its promised higher throughputs.

Thus, we propose that the FCC should allow the use of low-power devices in U-NII-5 and U-NII-7 bands alongside U-NII-6 and U-NII-8 without the need of any AFC system. This will make sure that Wi-Fi connects and provides the necessary throughput to all indoor devices without causing any interference to current incumbents across all 6 GHz bands.

## U-NII-6 and U-NII-8

U-NII-6 band is composed of 100 MHz and U-NII-8 band is composed of 250 MHz. Currently, these bands are used for mobile services, such as the Broadcast Auxiliary Service and Cable Television Relay Service, as well as fixed and fixed satellite services.

### Support of Low-Power devices in U-NII-6 and U-NII-8 without AFC

In rule (ii) FCC has proposed to use these bands for low-power unlicensed devices without the need of an AFC like system. This is a very welcoming step and we support this as it shall enhance the feasibility of unlicensed devices to work seamlessly in indoor environments without causing any interference to its current incumbents without any AFC like management system.

### Support of High-Power devices in U-NII-6 and U-NII-8 without AFC

The main issue for AFC type usage in these bands is the nature of Mobile Services which are used by news agencies making it difficult to predict the location and interference power. However, if we analyze the RKF study<sup>1</sup> then we see that on average the effect of Wi-Fi transmission on mobile services is very negligible. Therefore, we support the idea that in the U-NII-6 and U-NII-8 sub-bands standard power unlicensed devices should be allowed to operate without the control of an AFC system.

## Concerns on AFC

Next, we would like to provide some comments and concerns on automated frequency coordination (AFC):

- i. AFC is envisaged to be a simple database which is easy to implement and access, and this is exactly how it should be. FCC very rightly has so many questions and concerns around the role of AFC and its implementation, that it has the potential to turn into a very complicated and time-consuming debating issue. Instead we would like to propose to keep the AFC itself and its rules/regulations, access, fees and security requirements as simple as it is envisaged to be by the FCC.
- ii. It seems that there is an inclination towards centralized AFC systems, that is, before any operation each unlicensed Access Point device shall have to obtain the list of usable frequency channels at that physical location from a centralized AFC database system and then update its operating frequency channel. This centralized AFC system can be maintained by various FCC approved bodies. Operators and vendors should be free to be able to choose among these FCC approved bodies.
- iii. However, we support that de-centralized AFC systems should also be considered and evaluated before making any regulations about AFC.
- iv. The FCC seeks comments about the requirements for certified professional installation for the Master unlicensed devices. We would like to comment that there should be no such requirement made mandatory as it shall prohibit the retail market from designing and producing 6 GHz compatible devices.

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<sup>1</sup> [https://ecfsapi.fcc.gov/file/101261169015803/6%20GHz%20Ex%20Parte%20\(Bureaus\).pdf](https://ecfsapi.fcc.gov/file/101261169015803/6%20GHz%20Ex%20Parte%20(Bureaus).pdf)

- v. Device registration and/or transmitter identification is unnecessary for interference avoidance and, therefore, should not be required in the AFC database or by the AFC operator. A requirement for either or both may add cost and complexity with no additional interference avoidance benefits.
- vi. In our view AFC should use FCC's universal licensing system (ULS) data which should update the AFC list as frequently as ULS data is updated. AFC data shall not be updated on a daily/weekly basis hence a sequential update of AFC data once a month should suffice as FS links don't change their positions very frequently.
- vii. For the accessibility, AFC database should be available all the time and it should provide the list of available frequencies and allowed power levels associated to those frequencies. However, AFC in no form should be allowed to control any device. Devices should be made aware of the changes to ULS when they re-check the AFC and potentially learn that a previously assigned frequency is no longer available, or not available at a previously designated power level.
- viii. From security requirements point of view, AFC operators should not store any data from any device and should always provide the list of available frequencies and respective power levels after authentication of the interested device's credentials. These credentials shall be issued by the AFC operator and shall be associated to participating devices only.
- ix. We support the availability of multiple AFC operators. We see no need for devices to be able to communicate with all AFCs, so long as they are able to communicate with a certified AFC. So, any entity, including manufacturers can operate an AFC that supports only its devices as long as the AFC otherwise meets all the FCC-established AFC criteria.

## Comments on Out-of-Band Emissions (OOBE)

FCC has proposed that for all unlicensed devices operating in the 6 GHz band, all emissions below 5.925 GHz and above 7.125 GHz shall not exceed an EIRP of -27 dBm/MHz. FCC's rationale for this proposal on out-of-band emission limit is to be consistent with the rules that apply for most of the other U-NII bands, which have been successful in preventing harmful interference to services operating in adjacent bands. This is true for the U-NII-1 and U-NII-2 bands where out-of-band EIRP emission limit is also -27 dBm/MHz. However, for U-NII-3 this out-of-band EIRP limit is different and is presented in 15.407(b)(4)(i) and 15.407(b)(4)(ii). U-NII-3 band has more relaxed OOBE requirements towards the U-NII-4 which is being discussed for Dedicated Short Range Communications (DSRC) usage. This reduces the burden on the design of unlicensed devices operating in U-NII-3 bands as U-NII-4 is mainly used in Vehicular usage and poses no interference problem for U-NII-3. Similarly, U-NII-5 should have relaxed EIRP limits on the lower frequency side, that is towards 5925 MHz. This shall aide the filters design by margin and thus make it feasible for devices to be able to use most of the U-NII-5 band.

For visual aide, the NPRM based proposed EIRP limits are shown in the figure below in comparison to the U-NII-3 band for which the out-of-band emission limits were recently relaxed to facilitate the high usage.

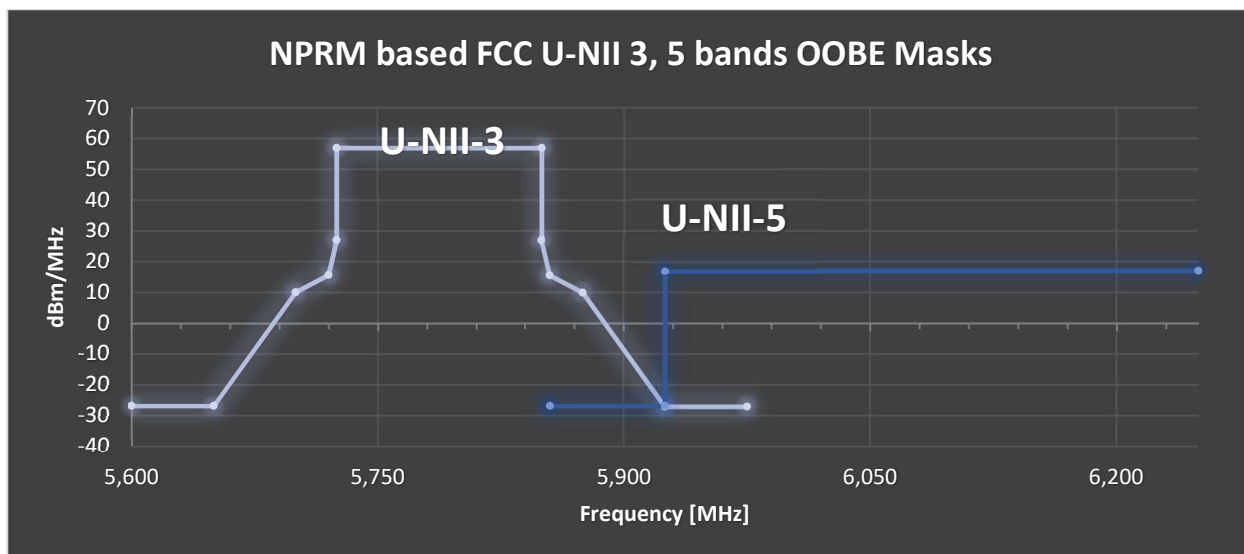


Figure 1 NPRM based proposed OOB Masks

In the Figure 2 below we show our proposed, more relaxed U-NII-5 OOB mask, which is in line with FCC latest UNII-3 requirements.

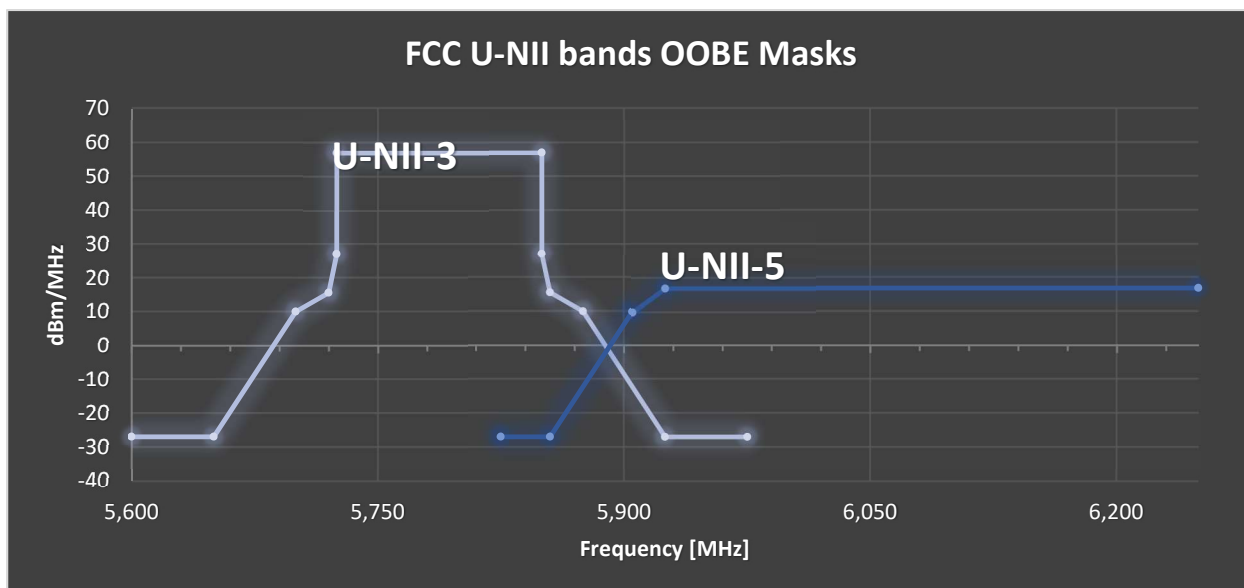


Figure 2 Quantenna's proposed OOB Mask

We propose that U-NII-5 band should have similar type of out-of-band EIRP limit as U-NII-3. This would facilitate further the design of products for U-NII-5 band by posing less stringent requirements on U-NII-5 band edge.

## Increase Transmit power of unlicensed Client Devices

For the client devices, the maximum conducted output power is specified to be 63 milliwatts and maximum power spectral density is specified to be 5 dBm in any 1 megahertz band. This limit is applied to not only the handheld client devices but also to the set-top box client devices as well which are not master (Access Point) devices. This shall result in limiting the transmit power of such devices, resulting in less uplink direction power, which can limit the range in the indoor environments and thus can result in reducing the

uplink throughput. Historically, increasing downlink throughput has received more attention than its counterpart, i.e., uplink throughput, but recent trends of sharing more data via social or gaming applications have shown that uplink transmission throughput is at least as important as is the downlink throughput. Therefore, limiting the indoor transmit power of client devices to such a low transmit power is not useful for such a wide-band of transmission.

Thus, we propose that FCC considers increasing the transmit power limit from 63 milliwatts to the low-power device transmit power, that is, 250 milliwatts. This would help increasing the uplink throughput at wider range. Besides most of the client devices (handheld + set-top boxes) operate in an indoor environment and setting their transmit power to 250 milliwatts complies with already defined indoor transmit power limit.

### Access Mechanism:

There should be a well-regulated mechanism to allow access to the 6GHz unlicensed spectrum. For instance, in Wi-Fi the access of any frequency resource is carried out based on carrier sense multiple access (CSMA) mechanism where every device first listens to the medium to check its availability, and only if it is free for a certain duration, it starts utilizing the frequency resources. Otherwise it backs off for an exponential time. Other technologies that would use the 6GHz unlicensed spectrum should use similar fair mechanisms. More aggressive schemes, with no back-off mechanism for instance, would be detrimental to fair sharing of this spectrum.

Respectfully Submitted,

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